What Is Claimed Is:



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1. A method for down-converting an electromagnetic signal, comprising the steps of:

- (1) performing a matched filtering/correlating operation on a portion of a carrier signal;
- (2) accumulating the result of the matched filtering/correlating operation of step (1); and
- (3) repeating steps (1) and (2) for additional portions of the carrier signal, whereby the accumulation results form a down-converted signal.
- 2. The method according to claim 1, wherein step (1) comprises the step of convolving an approximate half cycle of the carrier signal with a representation of itself.
- 3. The method according to claim 1, wherein step (1) comprises the step of multiplying an approximate half cycle of the carrier signal by itself over a predetermined time interval and integrating over a predetermined time interval.

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4. The method according to claim 1, where $S_0(t)$ is an output of the matched filtering/correlating operation, k is a constant, $S_i(t)$ is an approximate half cycle of the carrier signal, and t_0 -0 is a predetermined time interval, and wherein step (1) comprises the step of processing an approximate half cycle of the carrier signal in accordance with:

 $S_0(t) = k \int_0^{t_0} S_i^2(t) dt$.

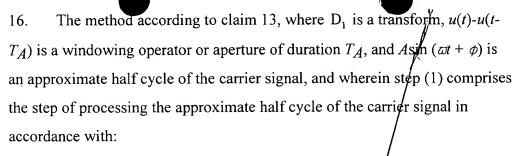
5. The method according to claim 1, where $S_0(t)$ is an output of the matched filtering/correlating operation, k is a constant, $kS_i(t,-\tau)$ is an impulse response of a matched filtering/correlating operator, t_0 is a predetermined observation time, $u(\tau)$ is a step function, and $S_i(t-\tau)$ is an approximate half cycle of the carrier signal, and wherein step (1) comprises the step of processing the approximate half cycle of the carrier signal in accordance with:

$$S_0(t) = \int_0^\infty \Big(k S_i \Big(t_0 - \tau \Big) u(\tau) \Big) S_i(t - \tau) d\tau.$$

- 6. The method according to claim 1, wherein step (2) comprises the step of transferring a portion of the energy contained in an approximate half cycle of the carrier signal to an energy storage device.
- 7. The method according to claim 1, wherein step (2) comprises the step of transferring a portion of the energy contained in an approximate half cycle of the carrier signal to a capacitive storage device.
- 8. The method according to claim 1, further comprising the step of:
- (4) passing on the accumulation result of step (2) to a reconstruction filter.
- 9. The method according to claim 1, further comprising the step of:
- (4) passing on the accumulation result of step (2) to an interpolation
- 10. The method according to claim 1, wherein step (3) comprises the step of repeating steps (1) and (2) at a sub-harmonic rate of the carrier signal.

11.	The method according to claim 1, wherein step (3) comprises the step
of repe	eating steps (1) and (2) at an off-set of a sub-harmonic rate of the carrier
signal.	
12.	The method according to claim 1, further comprising the step of:
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- (4) performing steps (1), (2), and (3) for positive approximate half cycles of the carrier signal and for inverted negative approximate half cycles of the carrier signal.
- 13. A method for down-converting an electromagnetic signal, comprising the steps of:
- (1) performing a finite time integrating operation on a portion of a carrier signal;
- (2) accumulating the result of the finite time integrating operation of step (1); and
- (3) repeating steps (1) and (2) for additional portions of the carrier signal, whereby the accumulation results form a down-converted signal.
- 14. The method according to claim 13, wherein step (1) comprises the step of operating on an approximate half cycle of the carrier signal with a filter having an approximately rectangular impulse response and integrating the output of the filter.
- 15. The method according to claim 13, wherein step (1) comprises the step of controlling a switch to pass an approximate half cycle of the carrier signal through the switch and integrating the output of the switch.



$$\sum_{1} = \int_{0}^{T_A} (u(t) - u(t - T_A)) \cdot A \sin(\omega t + \phi) dt$$

- 17. The method according to claim 13, wherein step (2) comprises the step of transferring a portion of the energy contained in an approximate half cycle of the carrier signal to an energy storage device.
- 18. The method according to claim 13, wherein step (2) comprises the step of transferring a portion of the energy contained in an approximate half cycle of the carrier signal to a capacitive storage device.
- 19. The method according to claim 13, where E is energy, A is a constant, $A \cdot S_i(t)$ is an aperture impulse response of duration T_A , and wherein step (2) comprises the step of accumulating energy from an approximate half cycle of the carrier signal in accordance with:

$$E = \left(\int_{0}^{T_{A}} A \cdot S_{i}(t)\right)^{2} dt.$$

- 20. The method according to claim 13, further comprising the step of:
 - passing on the accumulation result of step (2) to a reconstruction filter.
- 21. The method according to claim 13, further comprising the step of:
- (4) passing on the accumulation result of step (2) to an interpolation filter.

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1	The method according to claim 13, wherein step (3) comprises the step
2	of repeating steps (1) and (2) at a sub-harmonic rate of the carrier signal.
1	23. The method according to claim 13, wherein step (3) comprises the step
2	of repeating steps (1) and (2) at an off-set of a sub-harmonic rate of the carrier
3	signal.
1	24. The method according to claim 13, further comprising the step of:
2	(4) performing steps (1), (2), and (3) for positive approximate half
3	cycles of the carrier signal and for inverted negative approximate half cycles
4	of the carrier signal.
1	25. A method for down-converting an electromagnetic signal, comprising
2	the steps of:
3	(1) performing an RC processing operation on a portion of a carrier
4	signal;
5	(2) accumulating the result of the RC processing operation of step
6	(1); and
7	(3) repeating steps (1) and (2) for additional portions of the carrier
8	signal, whereby the accumulation results form a down-
9	converted signal.
1	26. The method according to claim 25, wherein step (1) comprises the step
2	of operating on an approximate half cycle of the carrier signal with an RC
3	filter and integrating the output of the RC filter.
1	27. The method according to claim 25, where h(t) is an impulse response
2	of an RC filter, R is an impedance, C is a capacitance, and $u(\tau)$ - $u(\tau$ - T_A) is a
3	windowing operator or aperture of duration T_A , and wherein step (1)

comprises the steps of:

(a) operating on an approximate half cycle of the carrier signal with an RC filter having an impulse response approximated by

$$h(t) = \frac{e^{\frac{-\tau}{RC}}}{RC} [u(\tau) - u(\tau - T_A)], \text{ and}$$

- (b) integrating the output of the RC filter.
- 28. The method according to claim 25, wherein step (1) comprises the step of controlling a switch to pass an approximate half cycle of the carrier signal through the switch and integrating the output of the switch using a capacitive storage device.
- 29. The method according to claim 25, wherein step (2) comprises the step of transferring a portion of the energy contained in an approximate half cycle of the carrier signal to a capacitive storage device.
- 30. The method according to claim 25, where C is a capacitance, R_s is a source impedance, and T_A is a time of an approximate half cycle of the carrier signal, and wherein step (2) comprises the step of accumulating a portion of the energy contained in the approximate half cycle of the carrier signal using a capacitive storage device chosen in accordance with:

$$C \ge \frac{T_A}{R_S(0.25)}.$$

- 31. The method according to claim 25, further comprising the step of:
 - (4) passing on the accumulation result of step (2) to a reconstruction filter.
 - 32. The method according to claim 25, further comprising the step of:

2	2	(4	4) passing on the accumulation result of step (2) to an
3	;	interpola	ation filter.
1		33. T	The method according to claim 25, wherein step (3) comprises the step
2	2.	of repeat	ing steps (1) and (2) at a sub-harmonic rate of the carrier signal.
1		34. T	The method according to claim 25, wherein step (3) comprises the step
2	2	of repeat	ing steps (1) and (2) at an off-set of a sub-harmonic rate of the carrier
3	3	signal.	
1		35. T	The method according to claim 25, further comprising the step of:
2	2	(4	4) performing steps (1), (2), and (3) for positive approximate half
3	3		cycles of the carrier signal and for inverted negative
4	ŀ		approximate half cycles of the carrier signal.
1		36. A	A system for down-converting an electromagnetic signal, comprising:
2	2	a	first matched filtering/correlating module that receives an input
3	3	signal, w	wherein said first matched filtering/correlating module down-converts
4	ļ	said inpu	at signal according to a first control signal and outputs a first down-
. 5	5	converte	d signal;
6	5	a	second matched filtering/correlating module that receives said input
7	7	signal, w	herein said second matched filtering/correlating module down-
8	3	converts	said input signal according to a second control signal and outputs a
9)	second d	lown-converted signal; and
10)	a	first subtractor module that subtracts said second down-converted
11	1	signal fro	om said first/down-converted signal and outputs a first channel down-
12)	converte	d signal

I	37. The system of claim 30, wherein said input signal is a Kr carrier signal
2	that is AM, FM, or PM modulated with an information signal.
1	38. The system of claim 37, wherein said first channel down-converted
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2	signal is a baseband signal.
1	39. The system of claim 37, wherein said first channel down-converted
2	signal is an intermediate frequency signal.
1	40. The system of claim 36, further comprising:
2	a third matched filtering/correlating module that receives an input
3	signal, wherein said third matched filtering/gorrelating module down-converts
4	said input signal according to a third control signal and outputs a third down-
5	converted signal;
6	a fourth matched filtering/correlating module that receives said input
7	signal, wherein said fourth matched filtering/correlating module down-
8	converts said input signal according to a fourth control signal and outputs a
9	fourth down-converted signal; and
10	a second subtractor module that subtracts said fourth down-converted
11	signal from said third down-converted signal and outputs a second channel
12	down-converted signal.
1	41. The system of claim 40, wherein said first subtractor and said second
2	subtractor each comprise a differential amplifier.
1	42. The system of claim 40, further comprising:
2	a first filter that filters said first down-converted signal;
3	a second filter that filters said second down-converted signal;
4	a third filter/that filters said third down-converted signal; and
5	a fourth filter that filters said fourth down-converted signal.

i	43. The system of claim 42, wherein said first, second, third, and fourth
2	filters each comprise a low-pass filter.
1	44. The system of claim 43, wherein each said low-pass filter comprises a
2	resistor and a capacitor.
1	45. The system of claim 40, further comprising a low-noise amplifier that
2	amplifies said input signal.
1	46. The system of claim 40, wherein said input signal comprises an RF I/Q
2	modulated signal.
1	47. The system of claim 46, wherein said first channel down-converted
2	signal comprises an I-phase information signal portion of said RF I/Q
3	modulated signal, and wherein said segond channel down-converted signal
4	comprises a Q-phase information signal portion of said RF I/Q modulate
,5	signal.
1	48. The system of claim 47, wherein a second control signal pulse of said
2	second control signal occurs 1.5/cycles of a frequency of said input signal after
3	the occurrence of a first control signal pulse of said first control signal;
4	wherein a fourth control signal pulse of said fourth control signal
5	occurs 1.5 cycles of said frequency of said input signal after the occurrence of
6	a third control signal pulse of said fourth control signal; and
7	wherein said third control signal pulse occurs .75 cycles of said
8	frequency of said input signal after the occurrence of said first control signal

pulse.

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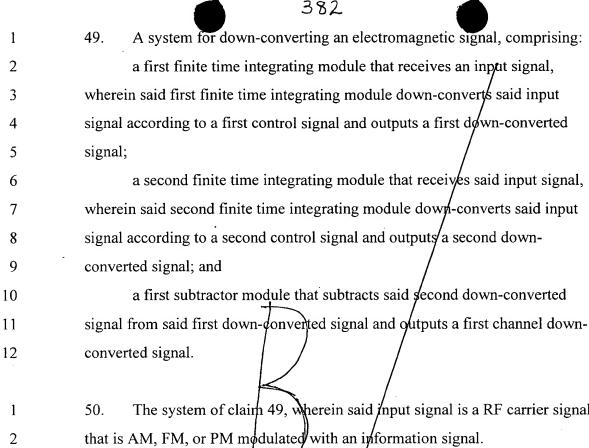
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- The system of claim 49, wherein said Input signal is a RF carrier signal that is AM, FM, or PM modulated with an information signal.
- 51. The system of claim 50, wherein said first channel down-converted signal is a baseband signal.
- 52. The system of claim 50, wherein said first channel down-converted signal is an intermediate frequency signal.
- The system of claim 49, further comprising: 53.

a third finite time integrating module that receives an input signal, wherein said third finite time integrating module down-converts said input signal according to a third/control signal and outputs a third down-converted signal;

a fourth finite time integrating module that receives said input signal, wherein said fourth finite time integrating module down-converts said input

8	signal according to a fourth control signal and outputs a fourth down-
9	converted signal; and
10	a second subtractor module that subtracts said fourth down-converted
11	signal from said third down-converted signal and outputs a second channel
12	down-converted signal.
1	54. The system of claim 53, wherein said first subtractor and said second
2	subtractor each comprise a differential amplifier.
1	55. The system of claim 53, further comprising:
2	a first filter that filters said first down-converted signal;
3	a second filter that filters said second down-converted signal;
4	a third filter that filters said third down-converted signal; and
.5	a fourth filter that filters said fourth down-converted signal.
1	56. The system of claim 55, wherein said first, second, third, and fourth
2	filters each comprise a low-pass filter.
1	57. The system of claim 56, wherein each said low-pass filter comprises a
2	resistor and a capacitor.
1	58. The system of claim 53, further comprising a low-noise amplifier that
2	amplifies said input signal.
1	59. The system of glaim 53, wherein said input signal comprises an RF I/o
2	modulated signal.

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1	60. The system of claim 59, wherein said first channel down-converted
2	signal comprises an I-phase information signal portion of said RF I/Q
3	modulated signal, and wherein said second channel down-converted signal
4	comprises a Q-phase information signal portion of said RF I/Q modulate
5	signal.
1	61. The system of claim 60, wherein a second control signal pulse of said
2	second control signal occurs 1.5 cycles of a frequency of said input signal after
3	the occurrence of a first control signal pulse of sald first control signal;

wherein a fourth control signal pulse of said fourth control signal occurs 1.5 cycles of said frequency of said input signal after the occurrence of a third control signal pulse of said fourth control signal; and

wherein said third control signal pulse occurs .75 cycles of said frequency of said input signal after the occurrence of said first control signal pulse.

62. A system for down-converting/an electromagnetic signal, comprising:

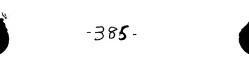
a first finite time integrating module that receives an input signal, wherein said first finite time integrating module down-converts said input signal according to a first control signal and outputs a first down-converted signal;

a second finite time integrating module that receives said input signal, wherein said second finite time integrating module down-converts said input signal according to a second control signal and outputs a second down-converted signal; and

a first subtractor module that subtracts said second down-converted signal from said first down-converted signal and outputs a first channel down-converted signal.

63. The system of claim 62, wherein said input signal is a RF carrier signal that is AM, FM, or PM modulated with an information signal.

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1	o4. The system of claim o5, wherein said this champ down-converted
2	signal is a baseband signal.
1	65. The system of claim 63, wherein said first channel down-converted
2	signal is an intermediate frequency signal.
1	66. The system of claim 62, further comprising:
2	a third finite time integrating module that receives an input signal,
3	wherein said third finite time integrating module down-converts said input
4	signal according to a third control signal and outputs a third down-converted
5	signal;
6	a fourth finite time integrating module that receives said input signal
7	wherein said fourth finite time integrating module down-converts said input
8	signal according to a fourth control signal and outputs a fourth down-
9	converted signal; and
10	a second subtractor module/that subtracts said fourth down-converte
11	signal from said third down-converted signal and outputs a second channel
12	down-converted signal.
1	67. The system of claim 66, wherein said first subtractor and said second
2	subtractor each comprise a differential amplifier.
1	68. The system of clam 66, further comprising:
2	a first filter that filters said first down-converted signal;
3	a second filter hat filters said second down-converted signal;
4	a third filter that filters said third down-converted signal; and
5	a fourth filter that filters said fourth down-converted signal.

69. The systel of claim 68, wherein said first, second, mird, and fourth 1 2 filters each comprise a low-pass filter. 70. The system of claim 69, wherein each said low/pass filter comprises a 1 2 resistor and a capacitor. 1 71. The system of claim 66, further comprising/a low-noise amplifier that 2 amplifies said input signal. The system of claim 66, wherein said input signal comprises an RF I/Q 72. 1 2 modulated signal. The system of claim 12 wherein said first channel down-converted 73. 1 2 signal comprises an I-phase information signal portion of said RF I/Q 3 modulated signal, and wherein said second channel down-converted signal comprises a Q-phase information signal portion of said RF I/Q modulate 5 signal. 74. The system of claim 73, wherein a second control signal pulse of said 1 2 second control signal occurs 1.5 dycles of a frequency of said input signal after 3 the occurrence of a first control signal pulse of said first control signal; wherein a fourth control signal pulse of said fourth control signal 4 5 occurs 1.5 cycles of said frequency of said input signal after the occurrence of a third control signal pulse of said fourth control signal; and 6 7 wherein said third ¢ontrol signal pulse occurs .75 cycles of said 8 frequency of said input signal after the occurrence of said first control signal pulse.

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